

February of which we have any record was that of 1868, with its mean temperature of 21.8°; that of 1855 gave us a minimum of 8° below zero, while the month just closed gave us a minimum of 4° below on the 6th.

New Mexico.—The past month was a record breaker for low temperatures, and will long be remembered as the coldest February in many years. The precipitation was above the normal and rather unevenly distributed.

North Carolina.—The current month was the coldest on record during the past quarter of a century; the mean for the whole State is the lowest for any month during that period, excepting January, 1893, which is 1.9° colder. The precipitation was 1.83 inch below the normal, but occurred mostly as snow and sleet, much of which remained unmelted on the frozen ground for nearly three weeks. The last five or six days of the month were pleasant and warm. The covering of snow is thought to have protected the wheat crops, and unless March is unreasonably warm there will be a fine fruit crop in North Carolina this year. The observer at Linville writes: "Temperature 16° below zero on the morning of the 8th, and the coldest known here; houses not calculated for such extraordinarily cold weather, which, however, was not felt as severely as it would have been at low altitudes on account of the dry air."

North Dakota.—The month has been nearly an average one as far as temperature is concerned, the departure from normal being only three-tenths of a degree below the usual temperature. The first ten days of the month were very severe, but after that time it was, as a general thing, mild and pleasant.

Ohio.—The month averaged 10.6° below the normal, and, with the exception of February, 1885, was the coldest February on record. Cold waves culminated on the 1st, 4th, and 8th, the latter producing the lowest temperatures of the month. The precipitation for the month was 3.01 inches below the average, and was the least monthly precipitation for February on record since the opening of the service. The percentage of verification of weather forecasts received from Washington and distributed to 120 points by telegraph and 800 by postal card was 90 for temperature and 93 for weather. All cold warnings were fully justified, and were of great benefit to the people of the State.

Oklahoma.—During the past month the average temperature was but 29.5°, or 9° below normal. On the 7th the average for the day was zero, which was the coldest weather ever recorded in February, and the coldest single day ever recorded in any month. Less precipitation fell in February than in any other month.

Pennsylvania.—With the exception of 1885, this was the coldest February in the past twenty years. Not only were unusually low temperatures recorded on the 6th, but the month was uniformly cold. The navigation of the Delaware River was practically closed for days to shipping. Many persons crossed the river on the ice between Philadelphia and Camden.

South Carolina.—The current month was an unusually cold one; in many instances it was reported as the coldest on record and as having the longest continuous freezing weather of which record has ever been made in this State. In the central portion of the State ice formed to a thickness of 0.5 inch, and in the southern portions ice formed on rivers that were never before known to freeze. The precipitation averaged 84 per cent of the usual amount. Farm work was greatly delayed. But little plowing could be done until near the end of the month, and then only on hilly and well-drained lands. The heavy snowfall of the 11-12th nearly all remained on the ground for about a week in the central portion of the State and protected grain crops, except that oats were badly damaged by the previous severe freezes.

South Dakota.—The mean temperature of the month was about 4.0° below the normal. The first decade of the month was very cold, with

the daily mean temperature below zero over most of the State. After the 15th it was comparatively mild. The 7th was the coldest of the winter, the average mean temperature of the four regular Weather Bureau stations for that day being 18° below zero. The greater part of the month cattle fed on the ranges over most of the State.

Tennessee.—The month of February, 1895, was phenomenally cold and dry. Snow covered the ground during the greater part of the month, affording valuable protection for wheat, which is now reported in excellent condition and growing well. The severe weather has doubtless caused much suffering to man and beast, but aside from this it has been beneficial to agricultural interests, in that it has killed off many insects and germs injurious both to vegetation and health. It has mellowed up the soil by prolonged freezing, so that it now responds readily to the plow; it has kept back the sap in fruit trees, so that our prospects for a good crop are brighter than for years. The precipitation, which has been unusually light, was almost entirely in the form of snow, which was well and evenly distributed throughout the State.

Texas.—The principal event of the month was the blizzard and weather of February 6-9th. An article by Dr. Cline states that notice of the approach of the norther was telegraphed or mailed to about 600 towns in Texas early enough to enable the citizens to protect their property. The prediction of high northerly wind for Galveston was utilized by the small vessels, and no damage of consequence was noted.

Utah.—This was an uneventful month. The weather throughout the Territory was generally clear and moderately warm, with light wind and about the average amount of precipitation. The average precipitation was slightly below the February normal.

Virginia.—Comparing records of Norfolk, Lynchburg, and Washington, D. C., we find this to have been the coldest February since the commencement of Weather Bureau records in 1871, and that the deficit was greatest in the southern sections of the State. Rains occurred on and near the coast on the 2d, 16th, and 19th; otherwise the total amounts of precipitation recorded for the State are about 40 to 65 per cent below the normal. The snow on the ground proved a great protection generally to winter crops until about the 25th, and then rapidly disappeared with warm weather. Preparation and burning of tobacco beds were being carried on in many sections the last days of February, and some plowing in progress.

Washington.—This has been a month of remarkably fine winter weather in this State. It was, on the whole, very much like February of 1893, although not quite so free from rain and slightly warmer. The amount of precipitation was 1 inch less than the average of six years, and the mean monthly temperature was 4.5° above the average. In western Washington some plowing and seeding was done in the warmer sections; flowers bloomed in the gardens and willow catkins opened in the forests; grasses and ferns remained green throughout the month. On the eastern side of the Cascade range spring-like conditions also prevailed. Some seeding was done; there was plenty of sunshine and flowers; larks and robins were reported. There were no storms during the month severe enough to do any damage.

West Virginia.—This has been an abnormally cold month, the coldest portion being from the 6th to the 11th, inclusive, temperatures below zero being recorded at nearly all stations on most of those dates. Precipitation, while deficient, fell in the form of snow and was unusually heavy in some localities.

Wisconsin.—This has been the coldest February since the establishment of the State Weather Service, and the Weather Bureau records at the Milwaukee station show but two instances where the monthly mean temperature for February was as low as during the past month. It is a fact worthy of note that the three coldest Februaries since 1871 occurred in regular order by decades, as follows; 1875, 1885, 1895. The average precipitation was 0.98 below the normal for February.

STUDIES BY FORECAST OFFICIALS.

As a preliminary to active duty, the forecast officials are given subjects for investigation from time to time. The following paper will be found of interest to all students of the problem of making weather forecasts:

A STUDY OF STORMS IN TEXAS.

By Prof. H. A. Hazen (dated January 29, 1894).

The following is "An examination of the low areas which formed over Texas, or on the Texas coast, during October, November, and December, with a view of determining the conditions which preceded their development, their probable movement, and the time required for the weather conditions attending them to extend to the Atlantic coast."

At the very first of this study it was found that the low areas which formed in Texas, or on the coast, were very few,

and it was decided to add a study of all cases of rainfall which began in Texas. It is easy to see that, after all, what is most needed is a study of the occurrence of rain, and it was found that nearly half the cases in October, and almost as many in November, were with an advancing high area. The maps studied were those prepared in the Forecast Division for the years 1880-'88, inclusive, making nearly 2,400 maps. Some puzzling cases of rainfall were found at Brownsville, and, to elucidate these, all the observations made at Tlacotalpan, in Mexico, on the Gulf of Mexico, were studied in connection with the United States maps. The motions of lower and upper clouds were also studied to determine their influence, if any.

In going through the maps copious notes were made of each map under study, and while these have been freely used in

making up this report, it was not deemed advisable to transcribe them fully. The number of cases of rainfall and the number of maps from which notes were taken are given in the following table:

Number of cases of rainfall and number of maps studied.

Year.	October.		November.		December.	
	Cases.	Maps.	Cases.	Maps.	Cases.	Maps.
1880.....	2	21	7	30	8	22
1881.....	5	16	5	21	5	37
1882.....	4	26	4	33	9	47
1883.....	1	8	4	15	6	33
1884.....	0	0	3	12	6	30
1885.....	2	7	3	16	3	20
1886.....	2	10	5	20	4	24
1887.....	5	31	2	20	8	52
1888.....	4	10	4	24	6	35
Total.....	25	129	36	194	55	299
Average.....	2.8	14.3	4.0	21.6	6.1	33.2

This table shows at once the gradual progression of the phenomena under study as the winter draws on. In fact, the driest month of the year at New Orleans is October (rainfall, 3.49, November giving 4.81, and December, 4.95). At Palestine, also, October is the driest of the three months. This is not the case, however, at Galveston, Brownsville, and San Antonio, but these studies included the Gulf and south Atlantic States. The rain at Galveston per storm was less in the later months, and this gave a slightly less rainfall, although the number of storms actually increased.

It is a little difficult to give a satisfactory summary of all these cases, and it should be remembered that what are given are the salient features of the precipitation as a whole.

OCTOBER.

In this month, more than in the others, there is a tendency to a diminished rainfall, with a *southerly wind*. A well-defined storm may originate in Texas, or traverse that State, and yet it is a curious fact that the south wind blowing off the great body of water in the Gulf does not give an abundance of rain. It is probable that nearly two-thirds of the cases of rain on the Texas Gulf in this month come with the north winds in the front of a high area or in the rear of the storm. This may be due in part to the fact that the rather cool gulf wind has its moisture or relative humidity diminished by the heated land. This rule is gradually overcome as the winter comes on, and in December most of the rain comes in front of the storm, while in the rear the north wind is rather drying. There are some difficulties in this explanation, and I merely present it as a working hypothesis.

RAIN FROM HIGH AREAS.

One of the peculiarities of the weather in October is the occurrence of rain, more or less severe, in the rear of a storm, or at other times in the front of a high area. Under these conditions, usually we have clear weather and the absence of rain. This phenomenon seems analogous to the occurrence of rain in the rear of storms in the Missouri Valley, which has been noted and commented on before. I could not find that the varying motion of clouds brought about the result. The rain is usually far more abundant at the shift of the wind or just at the beginning of the north wind, and the effect disappears when the high area wind has full sweep or is well established. It is probable that the upper current shifts a little before the lower, also the conditions left by the south wind may have brought about the rain with the oncoming colder north wind. I still regard this rainfall as difficult to explain.

The largest number of lows in October seem to come to

Texas from the west or south, though a very few recur from the Gulf. As a general thing, they are not marked by a great depression of air pressure, and, in fact, this may be said of nearly all the lows in this region during the three months. The most difficult conditions to forecast are those accompanying troughs of low pressure extending from Texas to Minnesota or the Lakes. Usually the northern part of this trough separates from the southern and goes on as an independent storm, leaving a disturbed condition in the Gulf. The motion of this disturbance is exceedingly irregular, but, in general, it moves very slowly along the Gulf coast to the south Atlantic and then up the coast. One peculiarity is that with this low there is not the usual clearing up in the rear, but rain may continue for thirty-six or even forty-eight hours.

Perhaps the most important condition to be watched under any circumstances is the behavior of the high area on the Atlantic coast. This high area is almost invariably found and often remains stationary on the middle Atlantic coast for thirty-six hours. If this moves off to sea the tendency is for the storm to develop and move after it. If the high area moves to the Nova Scotia coast, the storm will then begin to develop and will move rather slowly either along the Atlantic coast or from the middle Gulf to the upper Ohio Valley. If the high area gradually moves to the south Atlantic coast, the storm will move up the Mississippi Valley and the Atlantic coast will not get rain, except sometimes New England. I have devoted special attention to the movement of this high area, but can not lay down any rule as to when or under what circumstances it will settle over the south Atlantic coast or move to the northeast over Nova Scotia. It is possible that the observation at Bermuda might help out the study of this problem. At all events it would be a great advantage if a twice-daily observation were sent by mail from Bermuda and the record entered on the map.

NOVEMBER AND DECEMBER.

The storms in these months have about the same rate of motion as in October, but they develop into much more extensive storms and at times cover enormous regions. The trough conditions are especially marked in these months and are very difficult to positively forecast until they reach the Alleghanies. The prediction of rain with a north wind in Texas can not be ventured upon in these months, as there is a greater tendency for rain with south than with north winds.

I should say that rain is very difficult to forecast in Texas in the three months under study. The danger is of giving too much weight to threatening conditions. There is a certain condition of pressure which is invariably followed by clearing weather, i. e., a rise in pressure to the south of Texas, or sometimes over the State. This is almost an infallible sign and should be looked for with great care.

It is probable that the weather over the Gulf remains rather unsettled during these three months, though this occurs oftener in November and December than in October. The wind arrows frequently show such disturbance long before the pressure has been markedly affected.

In the course of my studies I have had occasion to examine critically all the storms of the Gulf that have approached the coast of Texas and the Southern States, and the list then prepared was published in the *WEATHER REVIEW* (see the *REVIEW* for November, 1893). The total number of these storms that reach the west Gulf is exceedingly small. I have found that in these months the Gulf storm frequently loses its intensity very rapidly. This was especially so in the case of the storm of October 12 and 13, 1886. The pressure at Galveston at 11 p. m. of the 12th was 29.35, but this was quickly diminished on the land, though giving a wind of 55 miles per hour from the southwest.